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on International Feed Barley Markets**

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The Impact of the Export Enhancement Program on International Feed Barley Markets

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ABSTRACT

A “hybrid” spatial price equilibrium model is developed to evaluate differences in trade flows and equilibrium prices for feed and malting barley exports from the U.S., Canada, Australia, and European Union, caused by the U.S. Export Enhancement Program (EEP). The analysis incorporates the relationships among several policy instruments.

I. INTRODUCTION

The Export Enhancement Program (EEP) was established in the United States through the 1985 Farm Bill. The most often cited reason for establishing EEP was to maintain export market share in the face of rapidly expanding grain exports from the European Union (Haley et al., 1992). While it is apparent that EEP has had some positive effect on U.S. barley exports, it is not clear that the benefits of the program outweigh the associated costs. EEP increases the volume of U.S. exports by lowering the price of imports paid by targeted countries. There are two costs associated with this program. First, the U.S. treasury must pay an amount equal to the EEP bonus multiplied by the quantity shipped. This is the explicit cost. However, there are also implicit costs involved with the program. EEP reduces the supply available to U.S. consumers, which causes the U.S. domestic price to rise. The United States then becomes a more attractive export market for outside suppliers such as the Canadian Wheat Board (CWB). For example, since the early 1990s, the United States has exported large quantities of feed barley, but has also imported significant amounts from Canada. In contrast, the volume of U.S. imports of barley from Canada prior to EEP was almost negligible.

This paper contains an economic analysis of the implications of EEP on international barley markets. It integrates the agricultural policies of each of the four major barley exporting regions (the EU-15, Canada, Australia, and the United States) to provide a model of production, consumption, stocks, and trade flows for feed and malting barley. The actions of competitive U.S. grain traders under EEP cause feed barley exports to be segmented into two distinct markets. The result is a “hybrid” spatial price equilibrium model in which the CWB and the Australian Barley Boards behave as duopolists in two distinct feed barley export markets under arbitrage conditions induced by the agricultural policies of U.S. and EU-15 exporters. This model is used to simulate international barley

markets under EEP levels that existed from 1991/92-1993/94, and then is used to determine what those markets would have looked like if EEP did not exist from 1991/92-1993/94.

II. THE EXPORT ENHANCEMENT PROGRAM

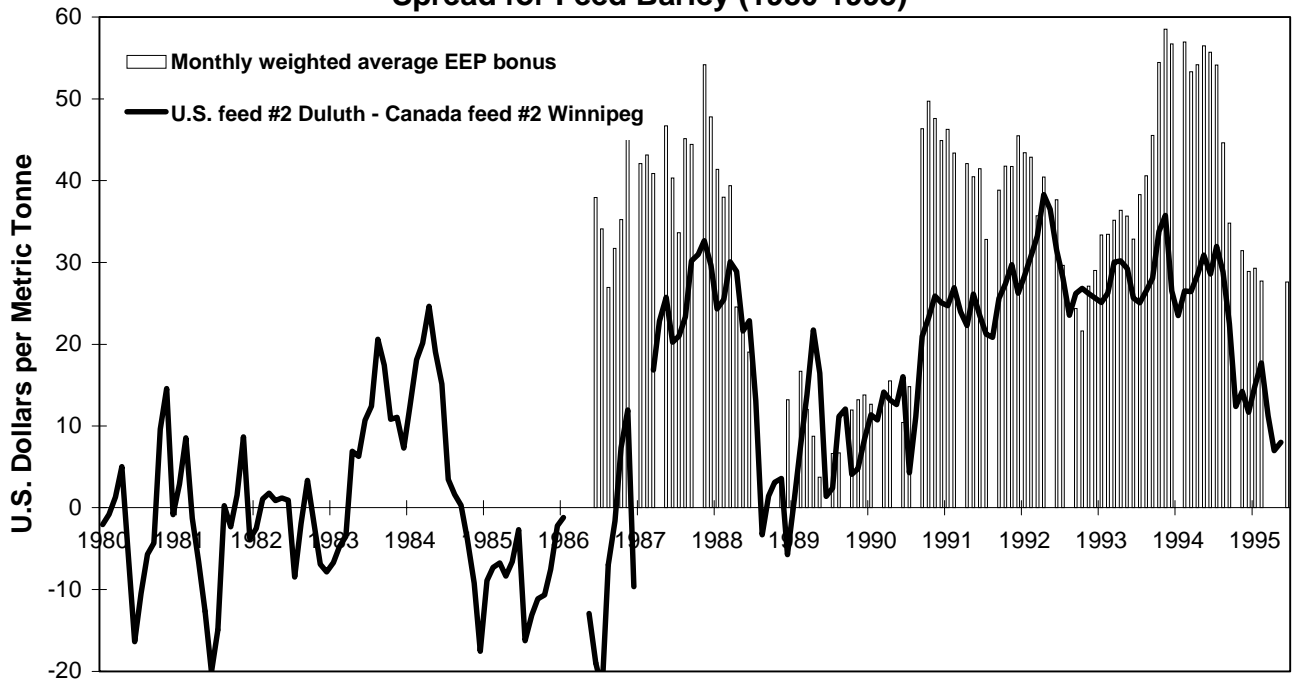
The Export Enhancement Program, established under the 1985 Farm Bill, provides subsidies to U.S grain companies on certain grain shipments sold to targeted countries. Algeria, Bulgaria, Cyprus, Egypt, the former Soviet Union, Iraq, Israel, Jordan, Morocco, Poland, Romania, Saudi Arabia, Slovenia, South Korea, and Tunisia have all benefited from lower prices due to EEP subsidies for feed barley. The first sale of feed barley under EEP occurred on May 7, 1986. The most recent sale of feed barley under EEP was made on June 14, 1995. Over the duration of EEP, bonuses were provided for nearly 15 MMT of feed barley with a cumulative value of \$541 million dollars. Hence, U.S. grain companies received a (weighted) average EEP bonus of \$36.25/MT. EEP bonuses have also been provided for malting barley exports. However, as of January 1, 1998, only five shipments of malting barley have been subsidized under EEP, compared to 296 shipments of feed barley. Hence, EEP does not play a major role in international malting barley markets. In addition, although Congress authorized the use of EEP under the 1996 Farm Bill, bonuses have not been provided for barley exports since 1995.

Over the nine-year period from 1986/87-1994/95, approximately 88 percent of all feed barley exported by the United States received EEP bonuses. The proportion of EEP payments to the total value of feed barley exports is much larger when compared to any other commodity that has received EEP bonuses. Hence, the international feed barley market is perhaps the most natural candidate for an analysis of the economic implications of EEP. The analysis provided herein focuses almost exclusively on the implications of EEP for international feed barley markets. For an analysis of malting barley markets see Schmitz and Koo, 1996 or Schmitz et al., 1997.

Over the duration of EEP, U.S. feed barley exports to the EEP market (those countries that have received EEP bonuses for imports of feed barley) were significantly higher than before EEP. However, the volume of Canadian exports to the EEP market also increased after 1985/86. In addition, once EEP was introduced, Canadian exports of feed barley to the United States increased significantly, reaching a historic level of 1.25 MMT in 1993/94. Part of this dramatic increase can be attributed to the fact that the CWB lost its monopoly export power over feed barley for six weeks in 1993, when Canada switched to a dual marketing system. However, the U.S. market would not have been attractive for Canadian producers if it were not for the increase in the difference between the U.S. and Canadian domestic price caused, in large part, by the high level of EEP bonuses provided by the United States in that year. The average EEP bonus for feed barley exports during the June-May crop year in 1993/94 was \$51.86, which is the highest bonus ever provided for feed barley exports by the U.S. on a yearly basis.

There exists a strong statistical relationship between the monthly weighted average EEP bonus provided by the United States and the U.S./Canada cash price spread for feed barley. This relationship is shown in Figure 1 for 1980-1995. The solid line depicts the difference between the monthly cash price of #2 feed barley at Duluth and the cash price of #2 feed barley at Winnipeg (both in U.S. \$/MT). The bars represent the monthly weighted average EEP bonus provided by the United States on feed barley exports to the EEP market. Before EEP was introduced into international feed barley markets, the cash price spread varied around the origin. In some months, the U.S. price was higher than the Canadian price, but in other months the Canadian price was higher. After June, 1986, the magnitude of the cash price spread is correlated with the magnitude of the monthly EEP bonus. As shown in the figure, in almost every month after 1986, the U.S. cash price was higher than the Canadian cash price.

Figure 1: Monthly EEP Bonus vs. the U.S./Canada Price Spread for Feed Barley (1980-1995)



Source: Monthly average EEP subsidy compiled from data supplied by Linda Beeler, USDA-ERS
Duluth #2 cash price is from USDA Feed Situation and Outlook reports. Various issues.
Winnipeg #2 cash price is from Grain Trade of Canada Catalogue 22-201. Statistics Canada. Various issues.

III. SIMULATION MODEL

In this section, an econometric simulation model is derived to estimate the economic impacts of EEP on international barley markets. The model is implemented in three stages. The first stage provides econometric estimates of domestic supply and demand conditions for both feed barley and malting barley in each of the four exporting countries. The second stage estimates links among prices received by farmers, domestic consumer prices, world prices, and the average per unit EEP bonus. The third stage generates estimates of feed barley import prices, stock adjustments, and trade flows from each exporting country to both the EEP and non-EEP market through the simultaneous solution of behavioral equations representing the profit maximizing behavior of the CWB and the Australian Barley Boards.

In the first stage, data on area planted to each type of barley, the selection rate, malting premiums, feed consumption, malting consumption, and ending stocks in each of the four exporting countries were used to estimate simple linear regressions with respect to expected prices, yield, and time. Most of these relationships were estimated for the period from 1980/81-1993/94. Supply equations were derived from the results of regressions on area planted multiplied by yield data. Demand equations were derived directly from the results of the regressions on consumption data. Malting barley consumption was approximated through a variety of methods, and then feed consumption was approximated as total barley consumption, minus malting barley consumption, plus stock adjustments.

The second stage establishes the relationships among prices received by farmers, domestic consumer prices, world prices, and the average per unit EEP bonus. Domestic prices in the four major exporting regions are linked to the prices received by farmers using a fixed basis. The domestic price is linked to world prices by assuming a set of behavioral constraints. Each of these constraints will now be discussed in turn.

First consider the European Union (EU-15). Because the export restitution payment system exists in the EU-15, European feed barley producers are insulated from changes in world feed barley prices. It is assumed that the domestic price of feed barley in the EU-15 is exogenous, as specified by the EU-15 governing body. Export restitution payments are calculated for both the EEP and non-EEP market by subtracting the world price in each market (eventually determined by the simulation) from the exogenous internal price. The quantity of EU-15 feed barley imported by the non-EEP market is specified as an increasing function of time. After satisfying demand in both the domestic and non-EEP market, the residual feed barley is assumed to be imported by the EEP market.

U.S. feed barley exports to the non-EEP market during periods when the EEP bonus was provided were almost negligible. Hence, the quantity of feed barley exported by the United States to non-EEP markets is assumed exogenous, and is set to its actual value to allow for cross-border traffic. In actuality, this value is small. For example, the United States exported an average of only 61,000 MT per year to the non-EEP market from 1991/92-1993/94. In addition, because there are many grain traders in the United States, it is assumed that the “law of one price” must hold from the U.S. perspective. That is:

$$(1) \quad P_F^{EP} = P_F^{US} - \delta + T_{US}^{EP}$$

where P_F^{EP} is the transportation inclusive price that a nation that receives EEP must pay to acquire feed barley imports. P_F^{US} is the cash price for #2 feed barley at Duluth. δ is the average per unit EEP bonus offered by the United States and T_{US}^{EP} is the average cost of transporting barley from the U.S. domestic market to the EEP market.

The CWB is the single-desk exporter of Canadian feed barley. It has some monopoly power in world feed barley markets because it can control the allocation of large volumes of feed barley sales across markets. This implies that the actions of the CWB affect the relationship between relative feed barley prices in the EEP and non-EEP market. However, the CWB can not directly enter its domestic cash market for feed barley. To account for this aspect of the Canadian marketing system, the CWB is assumed to be a price taker in its domestic feed barley market. Under this formulation, the domestic price for Canadian feed barley must somehow be linked to world prices. Unfortunately, under these conditions, there is no single “world price” that can be used for this purpose because the EEP bonus drives a wedge between the feed barley prices in the EEP and non-EEP market. It is assumed that the domestic price for Canadian feed barley is linked to world prices through the following relationship:

$$(2) \quad P_F^{EP} - P_F^{CN} = \alpha^{CN} + \beta^{CN} \delta$$

where α^{CN} and β^{CN} are parameters obtained through the ordinary least squares regression of the price difference $(P_F^{EP} - P_F^{CN})$ with respect to the EEP bonus δ . That is, the EEP bonus drives a wedge between the EEP market price and the Canadian domestic price. As the EEP bonus approaches zero, the Canadian domestic price of feed barley approaches the EEP market price minus the constant α^{CN} .

The Australian barley marketing boards function in a manner similar to the CWB. Australian barley marketing boards control Australian feed barley exports, but are assumed to be price takers in the Australian market for domestic feed barley. The domestic feed barley price in Australia is linked to world prices through a similar relationship:

$$(3) \quad P_F^{EP} - P_F^{AU} = \alpha^{AU} + \beta^{AU} \delta$$

where α^{AU} and β^{AU} are the Australian versions of their Canadian counterparts.

The allocation of feed barley across the EEP and non-EEP market is determined in the third stage through the simultaneous solution to the CWB and ABB profit-maximizing strategies. This synthetic simulation model is used to predict excess supply, import demand, and trade flows from the four major barley exporting regions. Specifically, it is assumed that the objective of the CWB is to maximize the revenue accruing to Canadian feed barley producers. The CWB can sell feed barley into four different markets: the Canadian domestic market (QF_{CN}^{CN}), the U.S. domestic market (QF_{CN}^{US}), the non-EEP market (QF_{CN}^{NE}), and the EEP market (QF_{CN}^{EP}). It will distribute its feed barley supply (S_F^{CN}) among these markets so as to solve the following:

Maximize total feed barley revenue for Canadian producers:

$$(4) \quad \begin{aligned} TR_F^{CN} = & P_F^{CN} QF_{CN}^{CN} + (P_F^{US} - T_{CN}^{US}) QF_{CN}^{US} + (P_F^{NE} - T_{CN}^{NE}) QF_{CN}^{NE} \\ & + (P_F^{EP} - T_{CN}^{EP}) QF_{CN}^{EP} \end{aligned}$$

with respect to QF_{CN}^{CN} , QF_{CN}^{US} , QF_{CN}^{NE} , and QF_{CN}^{EP} , subject to the structural constraints (1) through (3), and subject to the market clearing excess supply conditions:

$$(5a) \quad ES_F^{US} + QF_{CN}^{US} = QF_{US}^{NE} + QF_{US}^{EP}$$

$$(5b) \quad ES_F^{CN} = QF_{CN}^{US} + QF_{CN}^{NE} + QF_{CN}^{EP}$$

$$(5c) \quad ES_F^{AU} = QF_{AU}^{NE} + QF_{AU}^{EP}$$

$$(5d) \quad ES_F^{EU} = QF_{EU}^{NE} + QF_{EU}^{EP}$$

and subject to the market clearing excess demand conditions:

$$(6a) \quad ED_F^{EP} = QF_{US}^{EP} + QF_{CN}^{EP} + QF_{AU}^{EP} + QF_{EU}^{EP}$$

$$(6b) \quad ED_F^{NE} = QF_{US}^{NE} + QF_{CN}^{NE} + QF_{AU}^{NE} + QF_{EU}^{NE}$$

At the same time that the CWB is maximizing its producer revenues, the Australian marketing boards are doing the same. The only difference is that Australia does not export feed barley to the United States because it costs much more to transport grain from Australia than it does to transport grain from Canada. Hence, the Australian boards can sell feed barley into three different markets: the Australian domestic market (QF_{AU}^{AU}), the non-EEP market (QF_{AU}^{NE}), and the EEP market (QF_{AU}^{EP}). The Australian boards allocate feed barley supply (S_F^{AU}) across markets so as to solve the following problem:

Maximize total feed barley revenue for Australian producers:

$$(7) \quad TR_F^{AU} = P_F^{AU} QF_{AU}^{AU} + (P_F^{NE} - T_{AU}^{NE}) QF_{AU}^{NE} + (P_F^{EP} - T_{AU}^{EP}) QF_{AU}^{EP}$$

with respect to QF_{AU}^{AU} , QF_{AU}^{NE} , and QF_{AU}^{EP} ,

subject to equations (1-3) and (5a-6b).

To solve the allocation problems of the CWB and the Australian marketing boards simultaneously, it is assumed that these two countries interact with each other in a Cournot fashion under the segmented markets hypothesis. That is, they take each other's export quantities in each market as given when maximizing revenue. The solution to the feed barley simulation model involves a "hybrid spatial" solution concept. It is partly a competitive spatial price equilibrium model because of the behavior of the United States, and partly an oligopolistic

spatial model because of the behavior of the CWB and the Australian barley boards. The technique utilized to solve the feed barley portion of the simulation model is similar to that developed in Schmitz (1995).

The simultaneous solution to the maximization problems specified above generates two feed barley prices under Nash equilibrium conditions. One equilibrium feed barley price is generated for the EEP market and one price is generated for the non-EEP market. Equilibrium domestic feed barley prices in each of the exporting countries are obtained from these two prices through equations (1-3).

IV. EMPIRICAL RESULTS

The procedure described above is used to simulate international barley markets under EEP levels that existed from 1991/92 through 1993/94, and then is used to determine what those markets would have looked like if EEP did not exist from 1991/92 through 1993/94. The average EEP bonus provided for feed barley over this period was \$39.52/MT. In the base case, a voluntary export restraint is placed on Canadian exports of feed barley to calibrate the model. Canadian exports of feed barley to the United States are constrained so that they do not exceed the 3-year average level of 509,000 MT. In addition, U.S. feed barley exports to the non-EEP market are fixed at the 1991/92-1993/94 average of 61,000 MT.

Schmitz and Koo (1996) obtained estimates for the parameters associated with the supply and demand equations in the first stage. The estimates for the elasticity of feed barley demand with respect to the domestic feed barley price were -1.43 for the United States, -0.53 for Canada, -0.86 for Australia, and -1.32 for the EU-15. The main reason for these differences is that feed barley is the major feed grain in both Canada and Australia, hence their consumers (e.g. livestock producers) cannot substitute away from feed barley as readily as U.S. and EU-15 consumers can.

The equilibrium prices for feed barley imports generated by the model are \$92.37/MT and \$124.79/MT for the EEP market and non-EEP market, respectively. The equilibrium average price received by farmers for feed barley sales in the United States is \$85.14/MT. Total EEP subsidy payments provided by the U.S. Government equal \$93 million per year. The average EU-15 restitution payment for barley implied by the equilibrium prices is \$88.35/MT. This is more than double the U.S. EEP bonus of \$39.52/MT, and more than five times as high as the Canadian WGTA subsidy of \$16.65/MT. Given the prices and quantities generated by the base simulation, the price elasticity of excess demand is -1.01 and -0.46 for the EEP market and non-EEP market, respectively. Hence, the EEP market is more sensitive to the price of imports than the non-EEP market.

A second simulation was generated in which all exogenous variables remain the same as the base, except that the EEP bonus is set to zero. In the United States, the removal of EEP would have caused U.S. feed barley exports to drop to zero and would have increased carry-over stocks by 1 MMT. As a result, Canadian feed barley exports to the United States would have dropped by 327,000 MT because with the EEP subsidy removed, Canada has little incentive to export feed barley to the United States.

Why wouldn't the United States export any feed barley in the absence of EEP over the 1991/92-1993/94 period? Consider the actual trade flow data from 1993/94. Even with the large EEP bonuses offered during that year, the United States was actually a net importer of barley in 1993/94. The United States exported 1.2 MMT of feed barley, but also imported approximately that amount from Canada. These results indicate that while EEP results in higher export volumes and lower carry-over stocks, it does so at the expense of higher volumes of Canadian imports.

Intuitively, in the absence of EEP subsidies, Canada and Australia would reallocate exports to fulfill the feed barley import requirement in the EEP market. Australia would take a

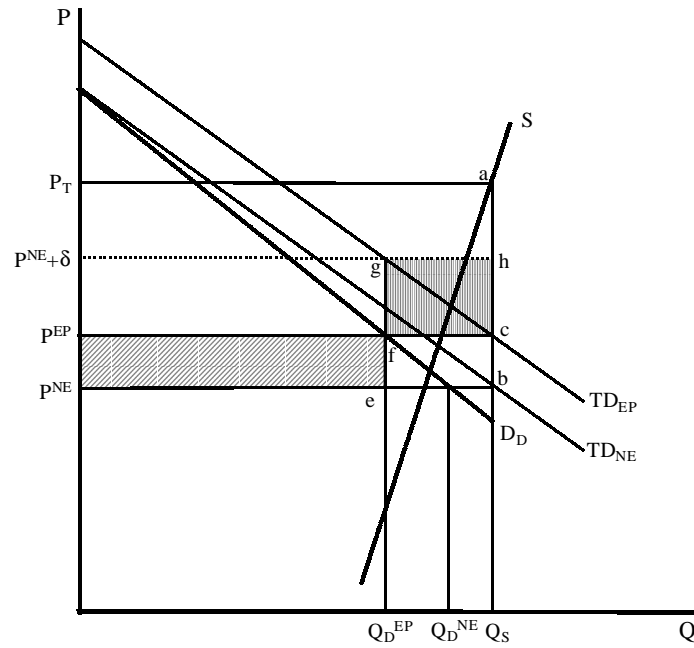
portion of its feed exports away from the non-EEP market in favor of the EEP market once the EEP subsidy was eliminated. Canada would reallocate some of the feed exports that had gone to the United States towards both the EEP market and the non-EEP market. This reallocation of exports, coupled with the elimination of the EEP subsidy, would have caused the equilibrium import price of feed barley to rise by \$26.65/MT and \$9.95/MT in the EEP market and non-EEP market, respectively.

The changes in equilibrium feed barley flows would have had a major impact on domestic prices. The average price received for feed barley sold by U.S. farmers would have dropped by \$12.88/MT if the average EEP subsidy had been eliminated. Hence, at the margin, an additional dollar spent on EEP would increase the average price received by U.S. farmers for feed barley by 33 cents.

From 1991/92 through 1993/94, the U.S. government paid an average of \$93 million per year in feed barley subsidies under EEP. However, the results obtained herein indicate that if EEP had not been in place from 1991/92 through 1993/94, the U.S. government would have saved \$93 million per year in EEP subsidies, but would have had to spend an additional \$135 million per year in deficiency payments to feed barley producers. Hence, total U.S. government payments used to support barley producers would have actually increased by an average of \$42 million per year if EEP had not been in place from 1991/92 through 1993/94. This result may be somewhat counter-intuitive.

In order to illustrate the theory behind this result, consider Figure 2 which graphically depicts the effect of EEP on government payments. First, consider the magnitude of total government payments under the 1990 Farm Bill in the absence of EEP. In Figure 2, S is the supply curve for feed barley in the United States, D_D is the U.S. domestic demand for feed barley, and TD_{NE} is the total demand curve in the absence of EEP. TD_{NE} equals the horizontal

Figure 2: The Effect of EEP on Government Payments



sum of the domestic demand curve and the excess demand curve for U.S. feed barley in international markets. P_T is the target price, which is assumed to remain the same with or without the presence of EEP. The target price of P_T causes the domestic price to equal P^{NE} in the absence of EEP. The U.S. consumes Q_D^{NE} and exports $(Q_S - Q_D^{NE})$ to the ROW. The government must pay an amount equal to the area P_TabP^{NE} in deficiency payments, because it must make up the difference between the target price and the domestic price on each unit sold.

Now consider the effect of EEP on government payments. In Figure 2, δ represents the average per unit EEP bonus provided for exports of U.S. feed barley. The imposition of EEP shifts the excess demand curve to the right, resulting in a similar shift in the total demand curve. However, for a given δ , the excess demand curve shifts by only a fraction of that amount, resulting in a total demand curve such as TD_{EP} in Figure 2. Assuming the target price remains the same, the new domestic price under EEP becomes P^{EP} , the United States reduces consumption to Q_D^{EP} , and exports increase to $(Q_S - Q_D^{EP})$. The government makes two separate

payments to support U.S. barley producers. The deficiency payment is reduced to $P_{Tac}P^{EP}$, but the government must make additional payments equal to the average EEP bonus multiplied by the total amount exported (area ghbe in Figure 2). In net, the total government payment under the 1990 Farm Bill is decreased by the cross-hatched area in Figure 2, because of the reduction in deficiency payments caused by the increase in the domestic price under EEP. However, the government must make additional payments equal to the vertically-hatched area (ghcf), due to the fact that the full effect of the EEP bonus is not transmitted to international markets.

From the above analysis, EEP causes total government payments to decrease if the cross-hatched area is larger than the vertically-hatched area in Figure 2. To get an idea for these magnitudes in the case of U.S feed barley during the 1991/92-1993/94 period, consider the results generated by the simulation model. In this case, a one percent increase in the average EEP bonus resulted in a 0.33 percent increase in the average price received by U.S. farmers. Hence, the height of the vertically-hatched area in Figure 2 is twice the height of the cross-hatched area. However, average feed barley consumption in the United States was approximately 5 MMT per year from 1991/92 through 1993/94, while the volume of U.S. feed barley exports averaged 1.7 MMT per year. Hence, the width of the vertically-hatched area in Figure 2 is only about one-third of the width of the cross-hatched area. This is the reason that the U.S. government saved \$42 million per year in government payments to support U.S. barley producers.

V. CONCLUSIONS

Empirical estimates of the impact of EEP on international feed barley markets were derived for the 1991/92 through 1993/94 period, a period that was also influenced by the deficiency payments provided under the 1990 Farm Bill. It was found that during this period, EEP decreased the average price paid for imports of feed barley by \$26.65/MT and \$9.95/MT in

the EEP market and non-EEP market, respectively. In addition, every dollar spent on EEP increased the average price received by U.S. farmers by 33 cents. Moreover, EEP reduced the total government payments used to support U.S. barley producers by an average of \$42 million per year. This is because the increase in the domestic price caused by EEP reduced the level of deficiency payments by more than the amount spent on EEP. EEP also helped to reduce carry-over stock levels significantly. However, EEP also caused a significant increase in the volume of barley imported from Canada by the United States.

From a welfare perspective, U.S. feed barley consumers lost more, in terms of consumer surplus, than U.S. barley producers and U.S. taxpayers gained. The results of this analysis suggest that EEP acts as a domestic subsidy whose side-effect is the indirect subsidization of foreign feed barley importers at the expense of U.S. taxpayers and foreign export competitors such as the EU-15, Canada, and Australia. However, in the case of feed barley, perhaps part of the reason that EEP was approved by the U.S. Congress was to decrease the overall treasury outlay required to support U.S. producers receiving deficiency payments prior to the 1996 Farm Bill.

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